

Mumps in the United States Background and Epidemiology

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Outline

- Introduction
- History
 - Pre-vaccine Era (1917-1967)
 - Vaccine Implementation (1968-1982)
 - Mumps Resurgence (1983-1992)
 - First National Outbreak (1993-2008)
 - Second National Outbreak (2009-2011)
- Recent mumps vaccine performance
- Summary

Mumps Symptoms

- Acute, viral illness that can present with
 - Classic:
 - Parotitis (60-70%)
 - Orchitis (30% in post-pubertal males)
 - Fever
 - Other:
 - Non-specific respiratory symptoms (40-50%)
 - Other salivary gland swelling (10%)
 - Complications:
 - Deafness (4%)
 - Aseptic meningitis (1-15%)
 - Encephalitis (0.03%)
 - Asymptomatic (30%)

Mumps Vaccine in the United States

- Licensed in 1967
- Composition
 - Live, attenuated mumps virus
 - Jeryl Lynn strain
 - Genotype A
- Effectiveness estimates¹
 - 1 Dose: ~77% (49-88%)
 - 2 Doses: ~88% (66-95%)

¹Schaffzin JK et al. *Pediatrics*. 2007;120:e862-8, Marin M et al. *Vaccine*. 2008;26:3601-7, Cohen C et al. *Emerg Infect Dis*. 2007;13:12-7, Deeks SL et al. *CMAJ*. 2011;183:1014-20, Dominguez A et al. *Vaccine*. 2010;28:3567-70, Sartorius B et al. *Euro Surveill*. 2005;10:191-3, Harling R et al. *Vaccine*. 2005;23:4070-4

Reported Characteristics of Mumps in Pre-vaccine Era

- Peak incidence in 5-9 year-olds¹
- 90% of children infected by age 14¹
- Most cases in late winter-spring²
- No remarkable geographic patterns³
- Most adult disease was associated with outbreaks in the military^{2,3}
- Significant cause of aseptic meningitis⁴

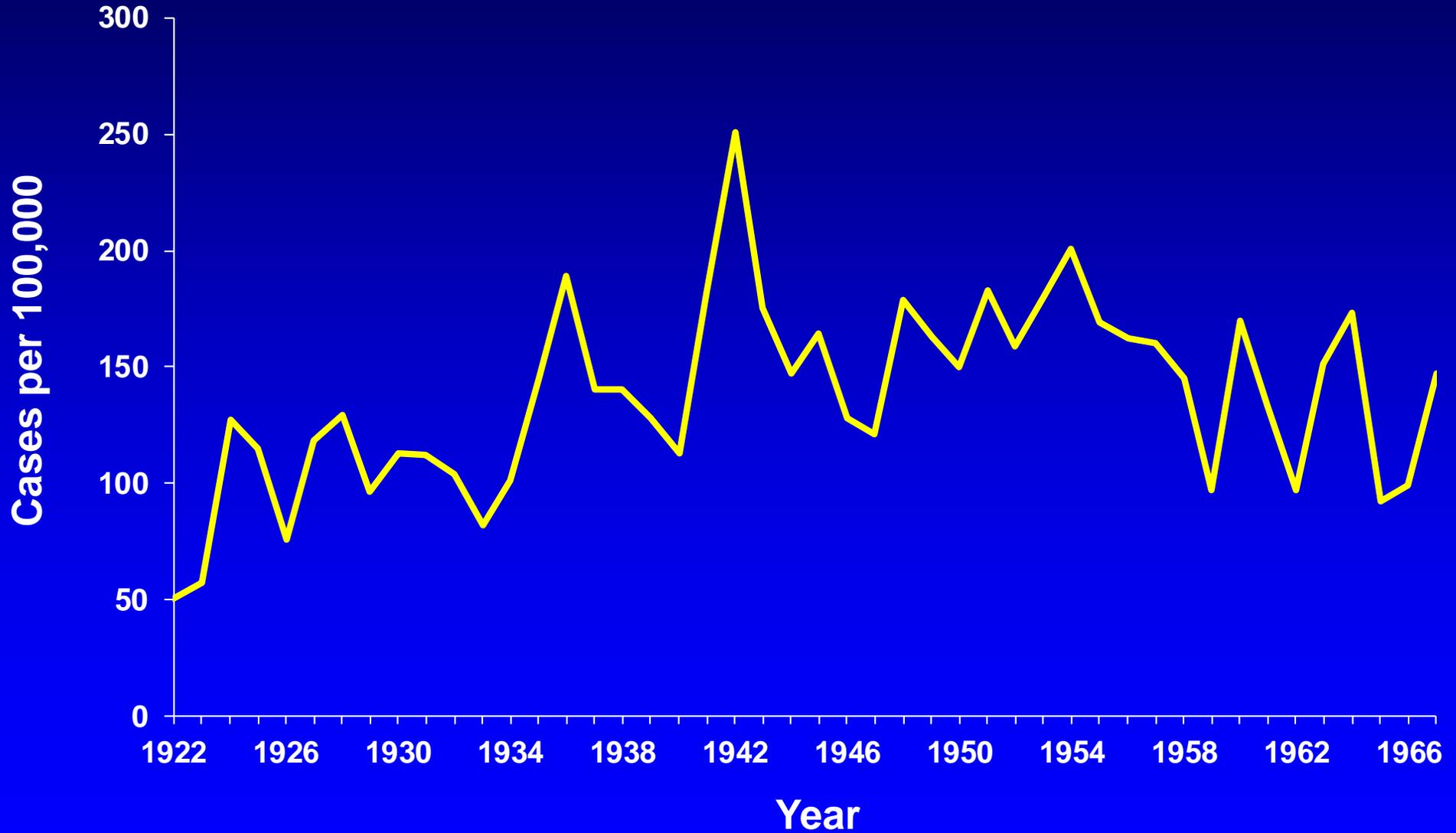
¹Collins SD. *Pub Health Rep.* 1929; 44:763-826

²Gordon JE. *Am J Med Sci.* 1940; 200:412-28

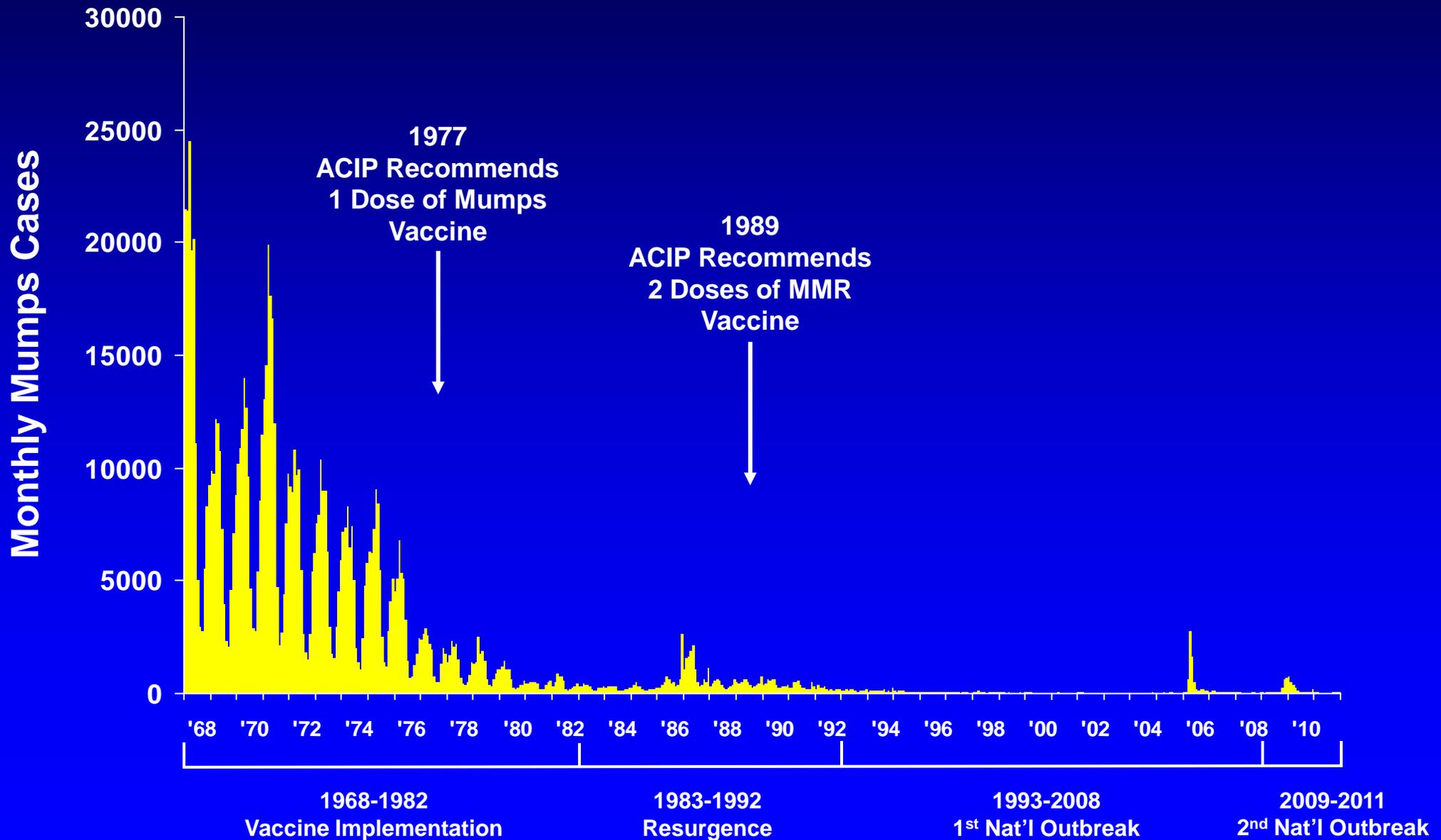
³Gordon JE. *Am J Med Sci.* 1949; 218:338-59

⁴USDHEW. *Mumps Surveillance: Report No. 1.* 1968

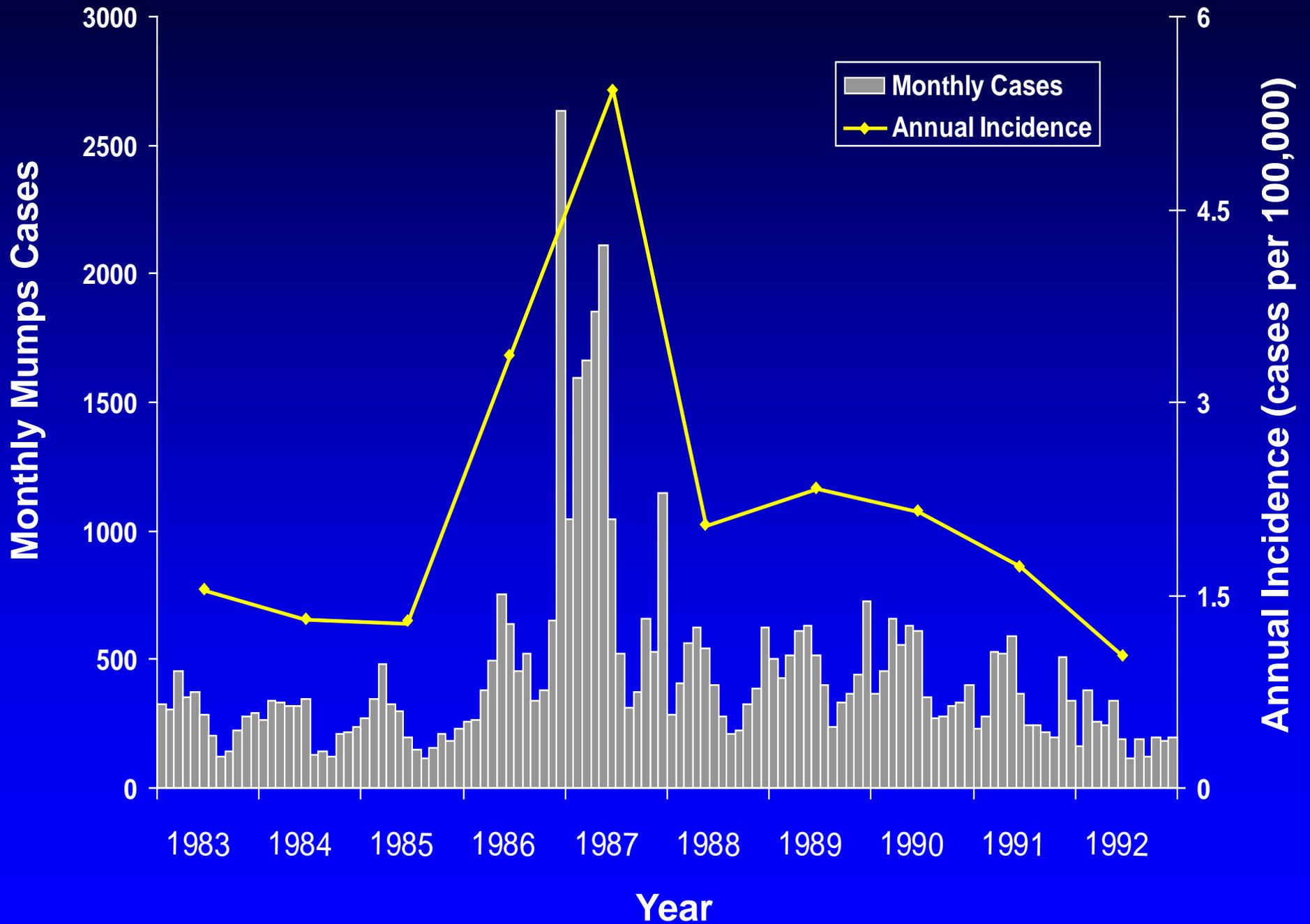
Mumps Incidence in the Pre-vaccine Era 1922-1967



Mumps, United States, Vaccine Era 1968-2011



Period of the Resurgence, 1983-1992



Observations on the Period of the Resurgence

- 1986-87 resurgence attributed to an increase in susceptibility among older children who
 - had not been vaccinated,
 - but who had been spared previous disease exposure by declining mumps incidence¹
- During 1988-92, outbreaks associated with 1-dose vaccine failure were first reported²⁻⁴

¹Cochi SL, et al. *Am J Dis Child.* 1988; 142:499-507

²Hersh BS, et al. *J Pediatr.* 1991; 119:187-93

³Cheek JE, et al. *Arch Pediatr Adolesc Med.* 1995; 149:774-8

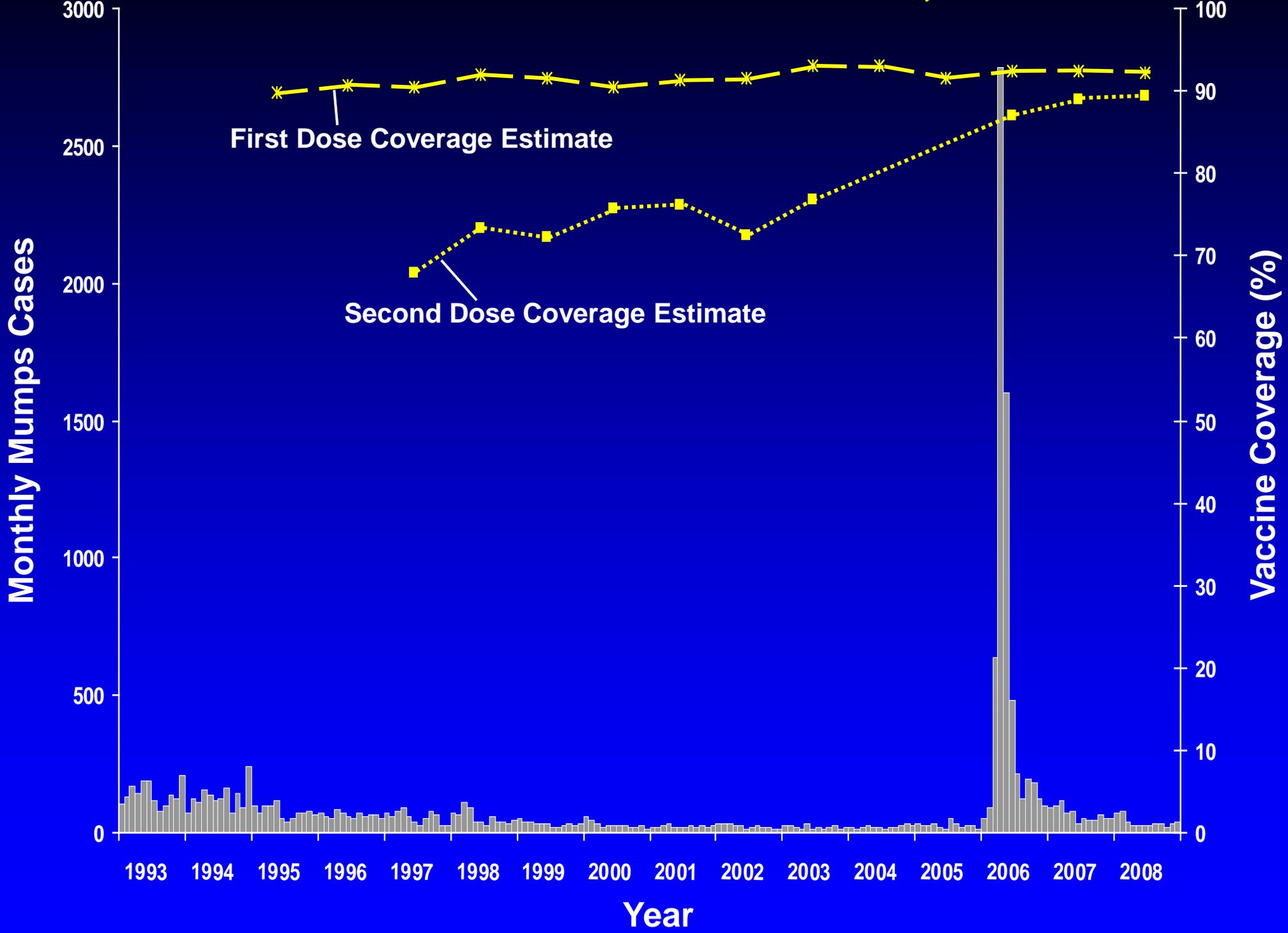
⁴Briss PA, et al. *J Infect Dis.* 1994; 169:77-82

1989 ACIP MMR Recommendation¹

- In December 1989, ACIP recommended a second dose of *measles* vaccine for improved measles control.
- Suggested it be administered as MMR, stating that “Mumps revaccination is particularly important.”
- Effectively, this was a recommendation for a second dose of mumps vaccine

¹ACIP. *MMWR Morb Mortal Wkly Rep.* 1989; 38(S-9):1-18

Period of the First National Outbreak, 1993-2008



Observations on the First National Outbreak

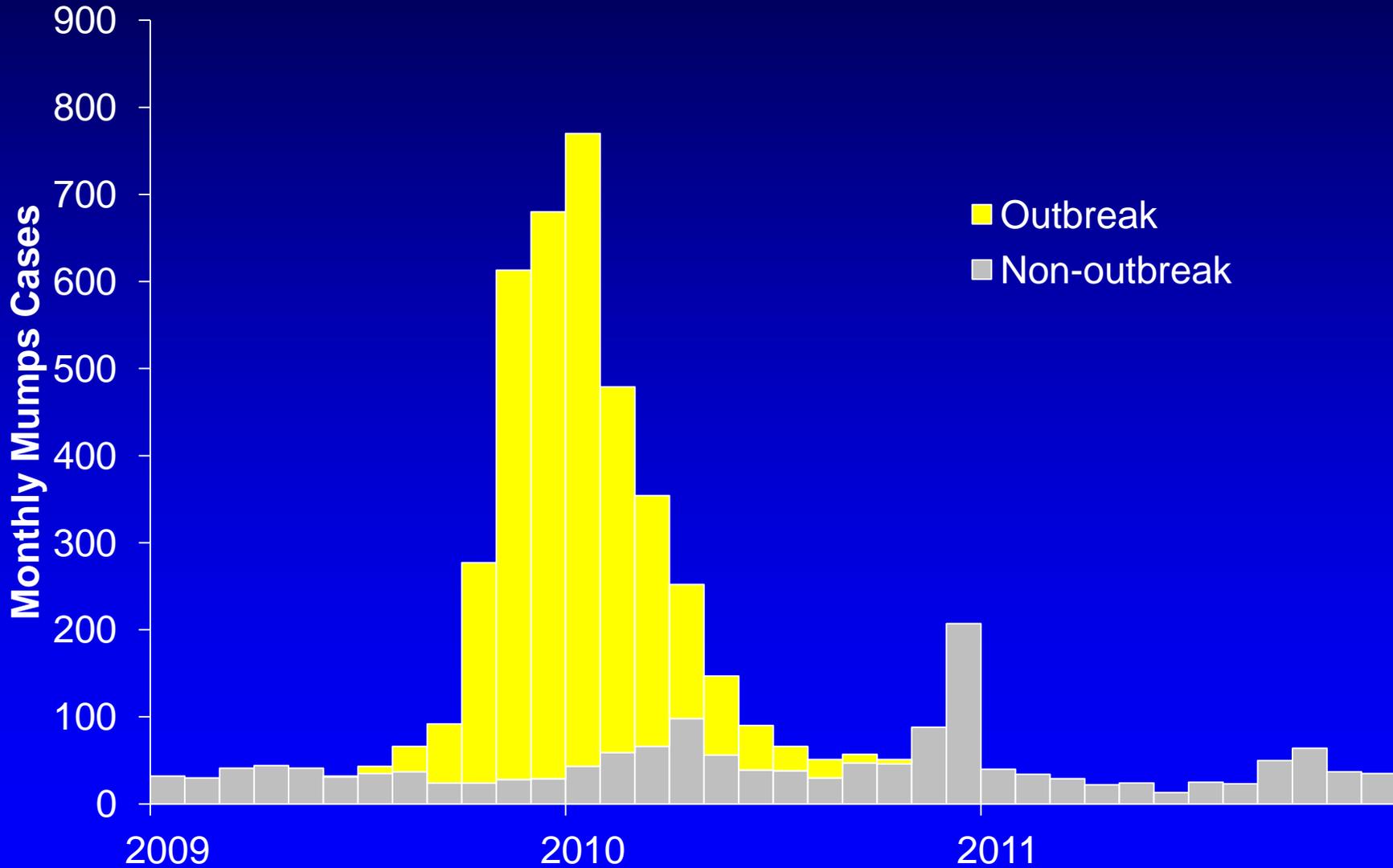
- First multi-state outbreak attributable to 2-dose vaccine failure
- Young adults 18-24 years of age were most affected
 - Most were college students
 - Almost all had had 2 doses of vaccine
 - Most had received them >10 years previously
 - Dormitory living and freshman class status were risks
- Geographically focused
- Sudden onset and sudden decline of cases

2006 ACIP Mumps Recommendation¹

- Formal recommendation for 2 doses of a mumps-containing vaccine for
 - School-aged children (grades K-12)
 - Adults in high risk groups
 - Healthcare facility workers
 - International travelers
 - Students at post-high school educational institutions

¹ACIP. *MMWR Morb Mortal Wkly Rep.* 2006; 55(22):629-30

Period of the Second National Outbreak, 2009-2011



Observations on the Second National Outbreak

- 97% of cases occurred within an Orthodox Jewish community
- Adolescent (13-17 years of age) males were the most affected group
 - Approximately 90% had 2 doses of vaccine
- Unique schools settings and large households were conducive to mumps transmission
 - Boys attend yeshiva, beginning ~age 12
 - “Chavrusa” style learning
- Prolonged, intense exposures likely overcame protection afforded by the vaccine

Guam 2010 Mumps Outbreak

- Middle school children (9-14 years of age) represented the most affected age group
- Among kindergarteners through middle school children attending public school, $\geq 95\%$ had received 2 doses of MMR

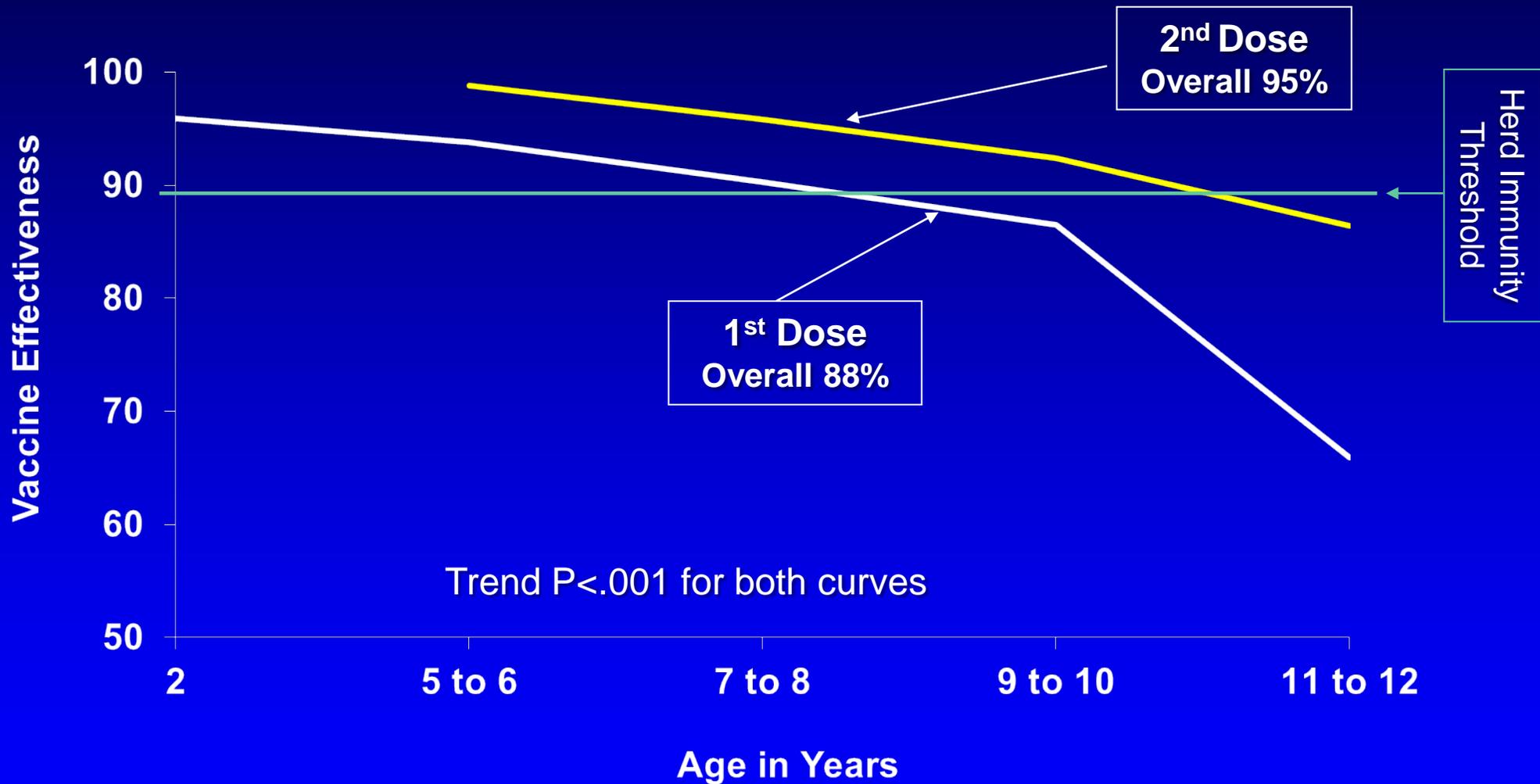
Recent Mumps Vaccine Performance

Postlicensure Vaccine Effectiveness Comparison of 1 vs 2 Doses

Outbreak Studied	Age Group	1 Dose	2 Doses	Reference
Canada outbreak 2009/2010	17-20	77	88	Deeks et al., CMAJ 2011
	14-18	49	66	
	6-15	77	84	
Spain outbreaks 2005/2007	4-12	85	89	Dominguez et al., Vaccine 2010
US (Iowa) outbreak 2006	18-25	82	79	Marin et al., Vaccine 2008
	18-25	64	88	
UK outbreak 2004/2005	2-12	88	95*	Cohen et al., EID 2007
Small outbreak US 2005	~7-49	80	92	Schaffzin et al., Pediatrics 2007
Small outbreak Sweden 2004	5-24	65	91	Sartorius et al., Euro Surveill 2005
UK outbreak 1998/1999	1-18	64	88	Harling et al., Vaccine 2005
Median		77	88	
Range		49-88	66-95	

* Statistically significant 1 dose 87.8% (83.1%-91.1%) and 2 doses 94.6% (92.9%-85.9%)

Age-specific Vaccine Effectiveness Estimates for 1 and 2 Doses of MMR Vaccine, UK, 2004-05 Outbreak



Mumps Vaccine

Duration of Immunity – 2 Doses

- Correlates of protection are not well defined
- Seropositivity declines over time¹
- Neutralizing antibody titers decline over time²
- Cellular immunity declines less than seropositivity over time (if at all)³

¹Davidkin I et al. *J Infect Dis.* 2008;197:950-6

²LeBaron CW et al. *J Infect Dis.* 2009;199:552-60

³Jokinen S et al. *J Infect Dis.* 2007;196:861-7

More Than Waning Immunity At Play in Recent Outbreaks

- Waning immunity does not explain
 - Geographic focal nature
 - Oldest vaccinated cohorts not always most affected
- Intense exposure settings account for these features

Summary of Mumps Disease in the United States

- Prior to use of the mumps vaccine, mumps was a universal disease of childhood
- Use of the mumps vaccine reduced disease levels >95%
- Current 2-dose schedule is sufficient for mumps control in the general population, but outbreaks can occur in well vaccinated communities
- Intense exposure settings and waning immunity appear to be risk factors for secondary vaccine failure